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(54) **COATED ARTICLE AND METHOD FOR MAKING SAME**

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(58) **Field of Classification Search**
USPC 428/336, 408, 698; 427/577
See application file for complete search history.

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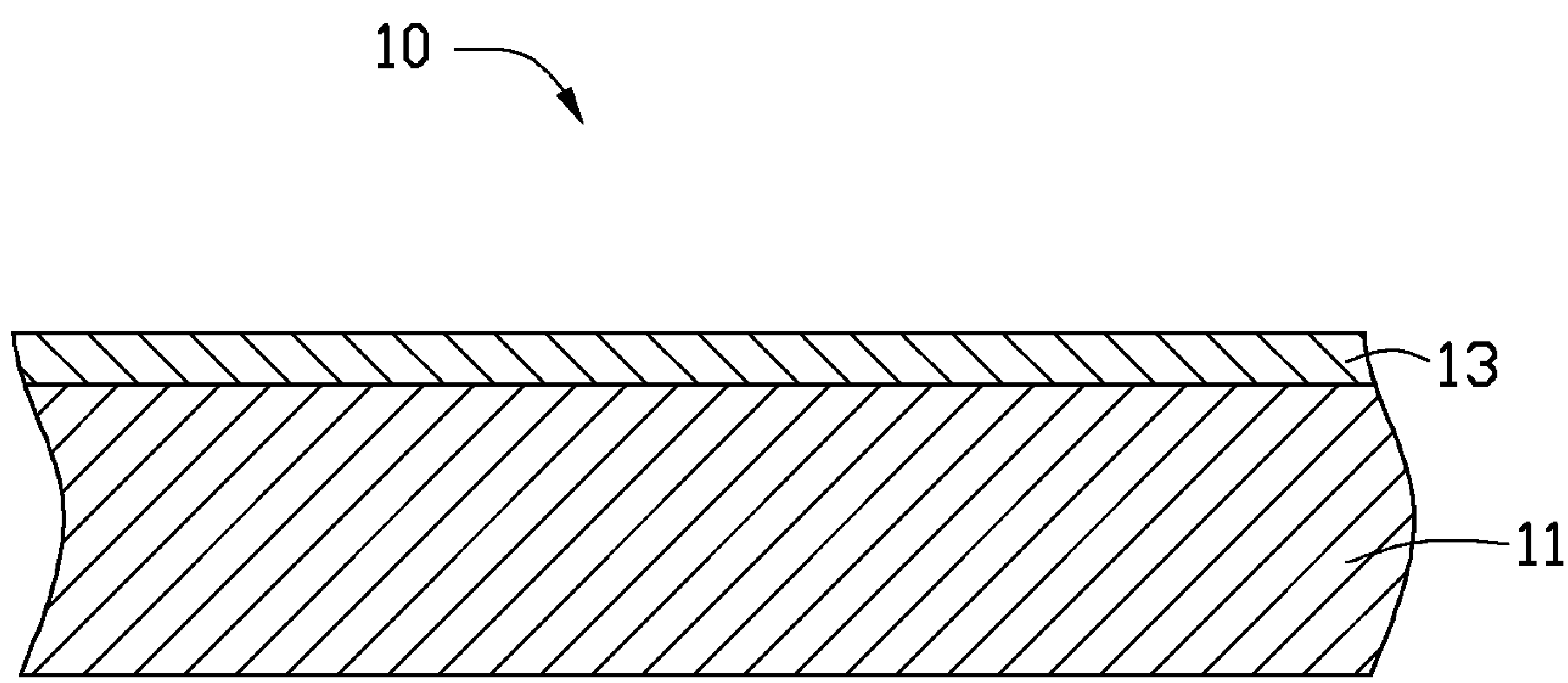
(57) **ABSTRACT**

A coated article is provided. The coated article includes a substrate, a hydrophobic layer formed on the substrate. The hydrophobic layer is an amorphous carbon nitride layer which is defined as CN_y, wherein y is in a range of from about 1 to about 3. The water contact angle of the hydrophobic layer **13** is about 100° to about 110°. The hydrophobic layer has a good chemical stability, high-temperature resistance and a good abrasion resistance, which effectively extends the use time of the coated article. A method for making the coated article is also described therein.

7 Claims, 2 Drawing Sheets



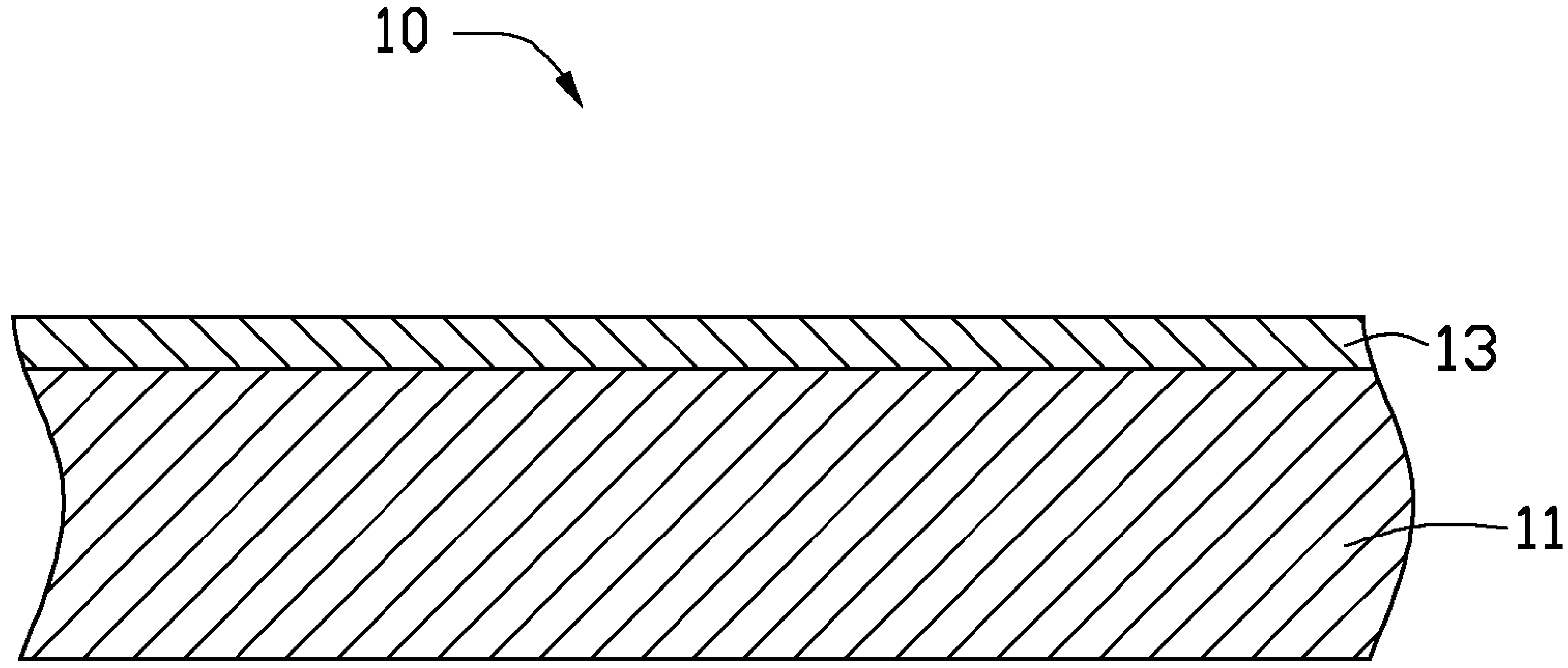


FIG. 1

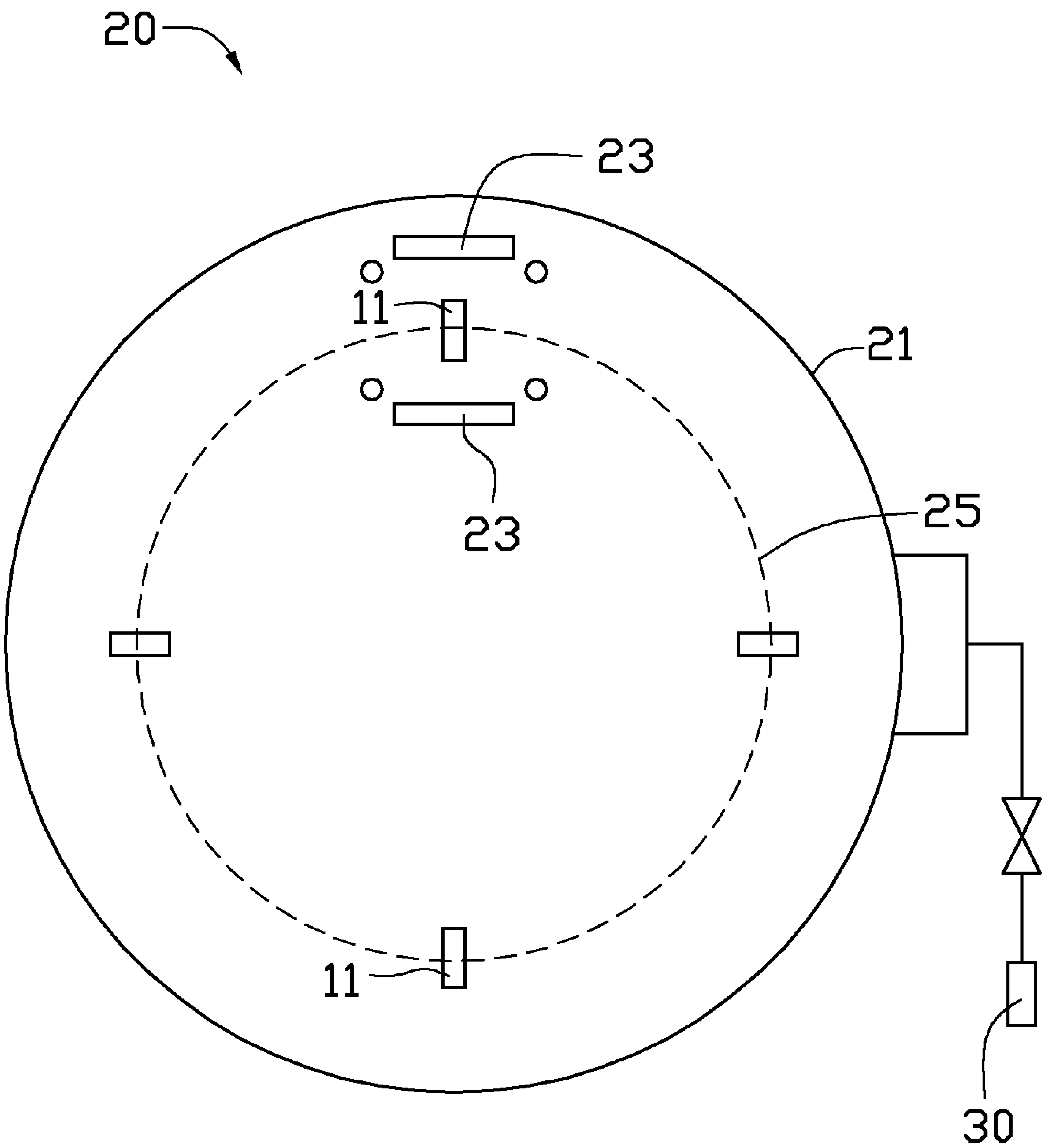


FIG. 2

COATED ARTICLE AND METHOD FOR MAKING SAME

CROSS-REFERENCE TO RELATED APPLICATIONS

The present application is related to co-pending U.S. patent application Ser. No. 13/166,318, entitled "COATED ARTICLE AND METHOD FOR MAKING SAME", by Zhang et al. These applications have the same assignee as the present application and have been concurrently filed herewith. The above-identified applications are incorporated herein by reference.

BACKGROUND

1. Technical Field

The present disclosure relates to coated articles, particularly to coated articles with hydrophobic property and a method for making the coated articles.

2. Description of Related Art

Good wetting property is important to solid surfaces. The solid surface, if being hydrophobic, requires that the water contact angle of the solid surface to be greater than 90°. To obtain a hydrophobic surface, the solid surface is usually coated with an organic hydrophobic layer. The organic hydrophobic layer is generally made of polymer material including fluorine and/or silicon. However, organic hydrophobic materials have shortcomings, such as low hardness, poor wear resistance and low heat-resistance temperature, which limits further applications of the organic hydrophobic materials.

Therefore, there is room for improvement within the art.

BRIEF DESCRIPTION OF THE FIGURE

Many aspects of the coated article and the method for making the coated article can be better understood with reference to the following drawings. The components in the drawings are not necessarily drawn to scale, the emphasis instead being placed upon clearly illustrating the principles of the coated article and the method. Moreover, in the drawings like reference numerals designate corresponding parts throughout the several views. Wherever possible, the same reference numbers are used throughout the drawings to refer to the same or like elements of an embodiment.

FIG. **1** is a cross-sectional view of an exemplary coated article;

FIG. **2** is a schematic view of a vacuum sputtering device for processing the coated article in FIG. **1**.

DETAILED DESCRIPTION

FIG. **1** shows a coated article **10** according to an exemplary embodiment. The coated article **10** includes a substrate **11** and a hydrophobic layer **13** formed on the substrate **11**.

The substrate **11** is made of stainless steel or glass.

The hydrophobic layer **13** is an amorphous carbon nitride layer which may be defined as CN_y layer, wherein $1 \leq y \leq 3$. An environmentally friendly vacuum sputtering process may form the hydrophobic layer **13**. The hydrophobic layer **13** has a thickness of about 200 nm to about 350 nm. The hydrophobic layer **13** has a low surface energy and the water contact angle of the hydrophobic layer **13** is about 100° to about 110°.

A method for making the coated article **10** may include the following steps:

The substrate **11** is pretreated. The pre-treating process may include the following steps:

The substrate **11** is ultrasonically cleaned with alcohol solution in an ultrasonic cleaner (not shown), to remove impurities such as grease or dirt from the substrate **11**. Then, the substrate **11** is dried.

FIG. **2** shows a vacuum sputtering device **20**, which includes a vacuum chamber **21** and a vacuum pump **30** connected to the vacuum chamber **21**. The vacuum pump **30** is used for evacuating the vacuum chamber **21**. The vacuum chamber **21** has a pair of graphite targets **23** and a rotary rack (not shown) positioned therein. The rotary rack drives the substrate **11** to revolve along a circular path **25**, the substrate **11** also revolves on its own axis while revolving along the circular path **25**.

The substrate **11** is plasma cleaned. The substrate **11** is positioned in the rotary rack of the vacuum chamber **21**. The vacuum chamber **21** is then evacuated to 3.0×10^{-5} Torr. Argon gas (abbreviated as Ar, having a purity of about 99.999%) is used as sputtering gas and is fed into the vacuum chamber **21** at a flow rate of about 500 standard-state cubic centimeters per minute (sccm). A negative bias voltage in a range of from about −100 volts (V) to about −180 V is applied to the substrate **11**, then high-frequency voltage is produced in the vacuum chamber **21** and the Ar is ionized to plasma. The plasma then strikes the surface of the substrate **11** to clean the surface of the substrate **11**. The plasma cleaning of the substrate **11** takes from about 3 minutes (min) to about 10 min. The plasma cleaning process will enhance the bond between the substrate **11** and the hydrophobic layer **13**.

The hydrophobic layer **13** is vacuum sputtered on the pretreated substrate **11**. Vacuum sputtering of the hydrophobic layer **13** is implemented in the vacuum chamber **21**. The vacuum chamber **21** is evacuated to 8.0×10^{-3} Pa and heated to about 180° C. to about 250° C. Ar is used as sputtering gas and is fed into the vacuum chamber **21** at a flow rate of about 300 sccm to about 500 sccm. Ammonia gas (NH_3) is used as reaction gas and is fed into the vacuum chamber **21** at a flow rate of about 200 sccm to about 320 sccm. The graphite targets **23** are then powered on and set to about 5 kw to about 10 kw. A negative bias voltage is applied to the substrate **11** and the negative bias voltage is from about −120 V to about −200 V. Depositing of the hydrophobic layer **13** takes about 38 min to about 55 min.

EXAMPLES

Experimental examples of the present disclosure are described as followings.

Example 1

The vacuum sputtering device **20** used in example 1 was a medium frequency magnetron sputtering device (model No. SM-1100H) manufactured by South Innovative Vacuum Technology Co., Ltd., located in Shenzhen, China.

The substrate **11** was made of glass.

Plasma cleaning: Ar was fed into the vacuum chamber **21** at a flow rate of about 500 sccm. A negative bias voltage of about −100 V was applied to the substrate **11**. The plasma cleaning of the substrate **11** took about 5 min.

Sputtering to form the hydrophobic layer **13**: The vacuum chamber **21** was heated to about 200° C. Ar was fed into the vacuum chamber **21** at a flow rate of about 350 sccm. Ammonia gas was fed into the vacuum chamber **21** at a flow rate of about 200 sccm. The power of the graphite targets **23** was 8 kw and a negative bias voltage of −120 V was applied to the substrate **11**. The depositing of the hydrophobic layer **13** took 40 min. The hydrophobic layer **13** had a thickness of about 200 nm.

Example 2

The vacuum sputtering device **20** used in example 2 was the same in example 1.

The substrate **11** was made of stainless steel.

Plasma cleaning: Ar was fed into the vacuum chamber **21** at a flow rate of about 500 sccm. A negative bias voltage of about −150 V was applied to the substrate **11**. Plasma cleaning of the substrate **11** took about 5 min.

Sputtering to form the hydrophobic layer **13**: The vacuum chamber **21** was heated to about 200° C. Ar was fed into the vacuum chamber **21** at a flow rate of about 250 sccm. Ammonia gas was fed into the vacuum chamber **21** at a flow rate of about 245 sccm. The power of the graphite targets **23** was 10 kw and a negative bias voltage of about −200 V was applied to the substrate **11**. The depositing of the hydrophobic layer **13** took 50 min. The hydrophobic layer **13** had a thickness of about 300 nm.

Results of the Above Examples

The water contact angles of the coated articles **10** made in example 1 and 2 were measured using a contact angle measuring instrument. The water contact angle of the hydrophobic layer **13** in example 1 and 2 is about 102.7° and 108°, respectively.

It is believed that the exemplary embodiment and its advantages will be understood from the foregoing description, and it will be apparent that various changes may be made thereto without departing from the spirit and scope of the disclosure or sacrificing all of its advantages, the examples hereinbefore described merely being preferred or exemplary embodiment of the disclosure.

What is claimed is:

1. A coated article, comprising:

a substrate;

a hydrophobic layer formed on the substrate, the hydrophobic layer being an amorphous carbon nitride layer which is defined as CN_y layer, wherein $1 \le y \le 3$.

2. The coated article as claimed in claim **1**, wherein the substrate is made of stainless steel or glass.

3. The coated article as claimed in claim **1**, wherein the hydrophobic layer has a thickness of about 200 nm to about 350 nm.

4. A method for making a coated article, comprising:

providing a substrate; and

forming a hydrophobic layer on the substrate by magnetron sputtering process using ammonia gas as reaction gas and graphite targets, the hydrophobic layer is an amorphous carbon nitride layer which is defined as CN_y layer, wherein $1 \le y \le 3$.

5. The method as claimed in claim **4**, wherein forming the hydrophobic layer uses argon gas as sputtering gas, the argon has a flow rate of about 300 sccm to about 500 sccm; ammonia gas has a flow rate of about 200 sccm to about 320 sccm; magnetron sputtering the hydrophobic layer is at a temperature of about 180° C. to about 250° C., the power of the graphite targets is about 5 kw to about 10 kw, a negative bias voltage of about −120 V to about −200 V is applied to the substrate, vacuum sputtering of the hydrophobic layer takes about 38 min to about 55 min.

6. The method as claimed in claim **4**, wherein the substrate is made of stainless steel or glass.

7. The method as claimed in claim **4**, wherein the hydrophobic layer has a thickness of about 200 nm to about 350 nm.

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